CYTEC

CYTEC INDUSTRIES INC.
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March 4, 2002
FEDERAL EXPRESS

Mr. Philip Rotstein
Remedial Project Manager
U. S. Environmental Protection Agency, Region III
1650 Arch Street, Mail Code 3HS23
Philadelphia, PA 19103-2029

Mr. Thomas D. Modena, P.E.
Environmental Technical Service Administrator
Virginia Department of Environmental Quality
629 East Main Street, 4th Floor
Richmond, VA 23219

RE: U. S. Titanium Superfund Site
Railroad Right-of-Way Evaluation
Response to EPA Comments & Revised Report

Gentleman:

Enclosed for your review and comment are two (2) copies of our responses to the comments provided by Mr. Philip Rotstein in his letter dated January 22, 2002 and a revised Report on Railroad Right-of-Way Evaluation at the U. S Titanium Superfund Site located in Piney River, VA. The revised report has been expanded to address the EPA's comments received on January 22, 2002.

Upon receipt of your approvals, we will prepare a workplan and project schedule for the proposed remedial activities. If you have any questions, please do not hesitate to contact me at 973-569-4009.

Very truly yours,

CYTEC INDUSTRIES INC.

Anton C. Marek, P.E.
Manager, Site Remediation

attach

cc: Wayne Lewis – Wiley & Wilson
D. Hearl – ESS
T. Waldman

prrcl

AR303186

44916

REPORT

ON

RAILROAD RIGHT-OF-WAY EVALUATION

FOR

pH, IRON and ACIDITY

U. S. Titanium Site
Piney River, Virginia

Prepared for:

Cytec Industries Incorporated
Morristown, New Jersey

Prepared by:

Wiley & Wilson
ARCHITECTS ENGINEERS PLANNERS

December 5, 2001
Revised March 4, 2002

AR303187

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TAB 1

1. INTRODUCTION

1.1. PURPOSE

A group of citizens in Amherst County and Nelson County, Virginia, in cooperation with the local governments, has been successful in obtaining "Rails to Trails" grant funding to convert the former Blue Ridge Railroad right-of-way to public use. The right-of-way bisects the U. S. Titanium Superfund Site, and as such, the condition of the site's soils, adjacent to the right-of way, is of concern. An initial investigation by the citizens' group revealed residual acidity in the drainage ditches running parallel to the proposed pathway as it traverses the site. The purpose of this report is to present the activities of the sampling event, assess the results of the laboratory analyses, and propose actions that may be taken in the area of the drainage path within the right-of-way.

1.2. SITE DESCRIPTION

The site lies within the property of a former titanium dioxide manufacturing plant. Approximately 50 acres of the 175-acre site are associated with Superfund remedial efforts. The site is located north of the Piney River, which is confluent with the Tye River to the southeast.

Ferrous sulfate (copperas), a by-product of titanium dioxide manufacturing, and metals (aluminum, iron, copper, nickel and zinc) are the primary site constituents. As a result of past waste disposal practices, the on-site groundwater is acidic. Six areas were identified during the Remedial Investigation/Feasibility Study (RI/FS) as requiring remedial action. These areas are shown in Figure 1 and listed below.

- Area 1, a burial pit containing 16,000 cubic yards of solid ferrous sulfate;
- Area 2, a former copperas stockpile area;
- Area 3, an evaporation pond;
- Area 4, a 1-acre ore waste pile;

- Area 5, sedimentation ponds containing fine-grained sediment composed of unreacted ore, filter cake, and gypsum, and;

- Area 7, a drainage area that received surface water runoff.

Area 6, a settling pond used to recover phosphate ore; did not require remediation.

Remedial construction activities (such as excavation, slope stabilization, regrading, revegetation, and waste containment) were completed from 1994 through 1996. Groundwater at the site is collected using a passive gravity collection system of perforated pipes located below the water table, down gradient from contaminated areas. The water is then pumped to an on-site treatment plant, where the water is neutralized and the metals are removed. The treated effluent is discharged to the Piney River through an outfall located southeast of the plant. The groundwater collection system and treatment plant have been in operation since 1996, with operations ongoing.

Monitoring of the treated effluent is conducted to evaluate compliance with regulatory discharge limits. In addition, biannual biological monitoring was conducted that specifically evaluated the available stream habitat, benthic macroinvertebrate communities, and select water quality parameters associated with the Piney River. Results indicate that the steam habitat and water quality are essentially equivalent at up-gradient and down-gradient locations. Comparisons of the macroinvertebrate data previously collected and the current data indicate a substantial and continuing improvement in the community attributes just downstream from the site discharge.

2. SAMPLING LOCATION AND ANALYSES

The purpose of collecting additional data was to characterize the site in the area of the railroad right-of-way. Soil samples were taken from 24 locations as shown in Figure 1.

All locations were verified by representatives from Wiley & Wilson. Central Virginia Laboratories & Consultants (CVLC) conducted the sampling. Three locations were added to the proposed locations as a result of the field pH readings. They were sample locations numbered 21, 22, and 23. Number 21 was added to obtain samples in the drainage swale west of Area 1 where the soil wetness became apparent in the swale. All locations in either direction of that location were dry. Number 22 was added to determine if field pH results from Location 1 were representative of the swale. Number 23 was added to determine if the swale bisecting the wetlands below the Area 1+3 collection system exhibited low pH, since Location 1 pH was relatively low, and Location 8 pH was relatively high. Locations 1 and 8 are at the inlet and outlet of the delineated wetlands situated immediately north of the railroad ditches. Location 1 is at the start of the low pH water's path as it migrates from Area 1 to the railroad ditches. Location 8 is at the outlet of this water's migratory route. The remaining samples were taken at paired locations situated in the drainage ditches that run on either side of the right-of-way. At each location, a sample was taken from depths of 6 and 18 inches and tested for field pH, total iron, and acidity.

Determination of the pH was accomplished in the field according to the CVLC's procedures as found in Appendix A of the Work Plan, which follows EPA approved Method SW-9040B. Total iron determination was accomplished according to the CVLC's procedures as found in Appendix A, and following EPA approved Method SW-7380. During sample collection, the auger was thoroughly cleaned between each use to ensure no cross contamination.

3. DATA MANAGEMENT

Environmental samples were submitted for analysis to CVLC, a laboratory licensed in the State of Virginia. The samples were analyzed for the pH, Total Iron, and Acidity using EPA approved methods. The CVLC Laboratory Report, including tracking and reporting data sheets, is included in Appendix A of this report. The results of the field and lab data have been compiled in Table 1 located after Section 4.

4. FUTURE ACTIONS

4.1 DATA ASSESSMENT

As indicated in the Work Plan addendum, the remedial action trigger level will be the pH readings of the samples at each location. If the average pH of the combined sample at each location is below 5 S.U., the vicinity of the location will be limed to a depth of 12 inches to raise the average soil pH to a minimum of 6 S.U. If the lower sample alone is below pH 5 S.U., the vicinity of the location will be limed to a depth of 12 inches to raise the pH to a minimum of 6 S.U. If the upper sample alone is below pH 5, the upper 6 inches of soil in the vicinity will be limed to raise the average pH to a minimum of 6 S.U.

Based on the above criteria, only four locations had an average soil pH above 5 S.U. for the 6-inch and 18-inch depth. They were Locations 2, 4, 8, and 21. Only Location 3 exhibited a soil pH above 5 S.U.'s at the 6-inch sample depth. All other locations exhibited soil pH values less than 5 S.U.'s at both depths.

Total Acidity, as $CaCO_3$, in the samples ranged from a low of 80 MG/KG (Location 3, 18-inch depth) to a high of 820 MG/KG (Location 21, 18-inch depth). Total Iron in the samples ranged from a low of 5,320 MG/KG (Location 8, 6-inch depth) to a high of 179,000 MG/KG (Location 6, 6-inch depth). There is no clear correlation between low pH, high iron, and high total acidity. The lowest total iron in Location 8 also exhibits total acidity of 800 MG/KG, near the highest total acidity of 820 MG/KG.

The set of readings for Location 21 indicates that current groundwater discharges to the swale are above pH 5. Location 21 was added during the sampling event to capture data at the only point in the swale that had an active groundwater seep during the recent dry weather. The extreme dry weather in recent years has essentially dried the soil in the remainder of the swale and in the wetlands fed by the swale. The pH readings at Location 21 averaged 6.13 S.U. Location 21 is the only sample point along this swale with a pH > 6 S.U. The other sample locations (1A, 1, 22, 8, and 23) all had soil pH values ranging from 3.85 to 4.55 S.U. Total Iron and Total Acidity at the 6-inch depth were 8,380 and 300 MG/KG, respectively. Total Iron and Total Acidity at the 18-inch depth were 23,800 and 820 MG/KG, respectively.

These data for Location 21 seem to indicate that the continued groundwater flow has been providing some flushing of residual iron and acidity at this location. The reason for this conclusion is that all sample points in this swale, including Location 21, are located within drainage paths where, historically (before the Remedial Action for Area 1 removed the source of acidity), low pH surface water and/or groundwater was the means of transporting iron and acidity to the swale area from Area 1. With the exception of this one location (#21) where sufficient groundwater flow continues to seep from the ground and flush the soil, the other sample locations in this swale exhibit a lower pH and a higher Total Iron level. The Total Acidity remains within the range of the other locations.

A similar observation is noted at other locations along the railroad ditches where some flushing continues to occur. At Location 2, surface water from offsite areas provides flushing of the north railroad ditch. At Location 3, a small drainage area from offsite provides flushing action. At Location 8, nearly all surface water runoff from the top of Area 1 to the north, from the Area 3 treated soil mound, and through the wetlands immediately north/northwest of Location 8 drains through the ditch at Location 8, thereby, providing significant flushing with fresh water for that single location. Comparing the condition of groundwater flow at Location 21 with the results of flushing conditions at Locations 2, 3, and 8, the similar test results at each location indicate both areas are being flushed, albeit from differing water sources and with differing volumes of water.

These readings also lend credence to the idea that the iron and acidity in the drainage paths, including the ditches along the old railroad bed, is residual rather than a result of current groundwater discharge to the drainage paths. There are no known remaining source areas to provide continuing high iron and acidity to supply the sampled locations. Observing conditions at the four locations that apparently are being flushed with fresh water as compared to the other sampled locations and the known most recent history of the site leads to the statement that the high iron and acidity is residual.

4.2 LIME APPLICATION METHOD

Based on the nearly universal distribution of low pH readings, the recommended procedure to remedy the low pH within the drainage ditches and drainage pathways is to apply lime and mix with the soil to a depth of 12 inches, as was done for Remedial Action (RA) for Area 2 and Area 7 Soil Remediation. (The text of the Closeout Report for the RA for Area 2 and Area 7 portion is provided at the end of this report section). The application of lime will be done by one of three methods: hand, small garden rotary tiller, or small backhoe. Where possible, the small tracked backhoe will dig 12 inches (depth) of soil in the drainage path and incorporate the designated weight of lime (in terms of pounds of lime per cubic foot of soil), then replace the mixture. This activity will occur over short lengths of ditch, beginning on the upstream end of each section. If a tracked backhoe cannot access a length of ditch without damaging the wetlands vegetation or vegetation that is to remain in place, either a small garden tiller and hand work will be used to remove the soil, mix the lime, and replace the mixture. If a tiller cannot access the location, only hand methods will be used. All lengths of the drainage ditches will be limed using one of the three methods.

4.3 METHOD TO DETERMINE LIME APPLICATION RATE

The amount of lime to be applied will need to be determined prior to start of work. This will be done using composite soil samples for discrete sections of the ditches, and mixing lime at different rates to determine the most reasonable application rate to raise the pH above 6 S.U. The final rate to be used will be the average of the predetermined rates for the discrete sections tested. The average of the predetermined rate (of lime application) will be the average of all test application rates that were successful in raising the soil pH of the composited samples for a section of ditch to pH 6 S.U. and less than pH 9 S.U. after 48 hours. The average will be used to allow for variability of soil acidity over the length of the ditch section.

The length of the sampling section will be determined based on the similarity of Total Acidity between adjacent locations. Similarity will be determined to be YES (TRUE) if the Total Acidity at the 6-inch depth for adjacent locations is within 20 percent of the average of the Total Acidity for the two locations (See Table 2 - Lime Rate Application Similarity). The process of determining final lime application rates will be the same (composites of samples from each 50 feet) regardless of ditch location.

For instance, Locations 3 and 5 exhibit similar readings for Total Acidity; therefore, equal aliquots of soil collected at 50-foot intervals from 100 feet upstream of Location 3 to the midpoint between Location 5 and Location 7 will be composited. The composite sample will be used to determine the rate of lime application for the ditch between Locations 3 and 5. For a station at the beginning of a series, upstream sampling will begin at an arbitrarily selected distance of 100 feet upstream from the location.

Since Location 5 and Location 7 are not considered similar, the lime application rate between Locations 5 and 7 will be determined by sampling beginning at the midpoint of Location 3 and Location 5, and ending at the midpoint between Location 7 and Location 10. When the Total Acidity is calculated as "similar" for a ditch length that includes several sampling stations, the sampling will begin at the midpoint upstream of the first station and continue to the midpoint below the last similar location.

Where the adjacent Total Acidity test results are not similar, such as Locations 4 and 6, the lime application rate between Locations 4 and 6 will be determined by sampling beginning at the midpoint of Location 2 and Location 4, and ending at the midpoint between Location 6 and Location 9. Table 3 summarizes the proposed sampling locations for the various segments of the ditches based on the above criteria.

4.4 EXTENT AND VOLUME OF SOIL REQUIRING TREATMENT

The total length of ditches (swale, north railroad, and south railroad) requiring lime addition is about 5,300 feet. The average width (for estimating purposes) is assumed at 36 inches, although some sections will require less than 36-inch width of treatment due to ditch geometry (narrow bottom with steep sides). The calculated volume of soil requiring lime addition is 589 cubic yards. If a rate of 6 tons per acre were required (comparable to our experience in Area 2), the equivalent lime per cubic yard is about 7-½ pounds, or approximately 4,400 pounds for the length of ditch anticipated. The actual rate will be established during the testing phase described previously.

Text from the Remedial Action Closeout Report for Area 2 and Area 7 Soils Remediation

"The seep areas in Area 2, adjacent to the streambed, consisted of mostly red clay that dried out when excavated and exposed to air. The top 12 inches of soil was removed and mixed with hydrated lime to a pH of 6 to 7 S.U. to support vegetation. The underlying soils were mixed in place with hydrated lime, to a pH of 7 to 9 S.U. The mixed in-place soil was then compacted, covered with the excavated, neutralized soil, and seeded.

"A total of 639 cubic yards was removed and treated over an area of 0.39 acre. The top 12 inches required about 0.5 percent (weight) lime to achieve the desired pH, while the substrate required about 1.5 percent (weight) lime to achieve the desired pH.

"In the streambeds where insufficient sediments were available to mix with hydrated lime, limestone rock was placed in the bed. A total of 125 tons of limestone (2 to 3 inch size) was used for this treatment.

"In Area 7, the soils were also very wet making it difficult to work with heavy equipment. However, O'Brien & Gere (OBG) found, after experimenting, that the soil could be removed and mixed satisfactorily if the equipment was not shifted until the work in the immediate vicinity of the

equipment was completed. In moving the equipment, soil moisture was drawn to the surface and bearing capacity of the soil was lost.

"By completing work in small areas, where possible, and not moving the equipment until it was completed, the soils were treated successfully. A total of 1,630 cubic yards of soil was excavated and neutralized, over an area of 1.01 acres.

"Area 7 also required the installation of a new culvert, which was completed before soils remediation started, and a rip rap lined drainage channel to control storm water runoff. The channel was completed in parallel with the soil remediation, from east to west".

TABLE 1 – SUMMARY OF SAMPLING RESULTS

Swale Section from Location 1A to Location 8

Sample No.	Sample Date	Sample Depth (inches)	Field pH (S.U.) (SW 9040)	Total Iron (MG/KG)	Acidity, Total (as CaCO3) (MG/KG)
1A	9/17/01	6	3.67	46,200	340
1B	9/17/01	18	4.06	28,200	200
Average			3.85		
1A-A	9/17/01	6	4.62	13,200	400
1A-B	9/17/01	18	4.48	27,300	360
Average			4.55		
8A	9/17/01	6	5.14	5,320	700
8B	9/17/01	18	5.88	16,600	150
Average			5.44		
21A	9/17/01	6	5.95	8,380	300
21B	9/17/01	18	6.31	23,800	820
Average			6.11		
22A	9/17/01	6	3.83	23,800	660
22B	9/17/01	18	3.94	28,600	800
Average			3.88		
23A	9/18/01	6	4.31	30,400	80
23B	9/18/01	18	4.44	27,500	120
Average			4.37		

TABLE 1 – SUMMARY OF SAMPLING RESULTS (continued)

North Railroad Ditch from Location 2 to Location 19

Sample No.	Sample Date	Sample Depth (inches)	Field pH (S.U.) (SW 9040)	Total Iron (MG/KG)	Acidity, Total (as CaCO3) (MG/KG)
2A	9/18/01	6	5.34	9,580	180
2B	9/18/01	18	5.66	19,800	160
Average			5.49		
4A	9/18/01	6	5.04	20,200	100
4B	9/18/01	18	5.09	17,000	200
Average			5.06		
6A	9/17/01	6	3.8	179,000	500
6B	9/18/01	18	4.2	25,900	520
Average			3.98		
9A	9/17/01	6	4	19,700	800
9B	9/17/01	18	4.08	18,200	400
Average			4.04		
11A	9/18/01	6	3.92	72,000	140
11B	9/18/01	18	3.89	24,600	140
Average			3.9		
13A	9/18/01	6	4.15	67,300	300
13B	9/18/01	18	4.07	35,900	280
Average			4.11		
15A	9/18/01	6	3.1	89,300	500
15B	9/18/01	18	2.87	91,100	700
Average			2.98		
17A	9/18/01	6	3.77	92,100	340
17B	9/18/01	18	3.26	73,900	340
Average			3.48		
19A	9/18/01	6	2.98	73,700	400
19B	9/18/01	18	3.09	87,300	360
Average			3.03		

TABLE 1 – SUMMARY OF SAMPLING RESULTS (continued)

South Railroad Ditch from Location 3 to Location 20

Sample No.	Sample Date	Sample Depth (inches)	Field pH (S.U.) (SW 9040)	Total Iron (MG/KG)	Acidity, Total (as CaCO3) (MG/KG)
3A	9/18/01	6	5.38	23,800	180
3B	9/18/01	18	4.37	33,700	80
Average			4.75		
5A	9/18/01	6	4.49	38,900	160
5B	9/18/01	18	4.38	37,000	200
Average			4.43		
7A	9/18/01	6	3.33	60,500	700
7B	9/18/01	18	3.8	18,400	300
Average			3.54		
10A	9/17/01	6	2.96	52,200	640
10B	9/17/01	18	3.38	69,100	800
Average			3.15		
12A	9/18/01	6	3.32	94,600	640
12B	9/18/01	18	4.78	32,500	440
Average			3.8		
14A	9/18/01	6	3.43	161,000	460
14B	9/18/01	18	4.01	58,000	120
Average			3.68		
16A	9/18/01	6	2.77	103,000	680
16B	9/18/01	18	2.57	175,000	800
Average			2.67		
18A	9/18/01	6	3.3	35,500	160
18B	9/18/01	18	3.47	21,200	100
Average			3.38		
20A	9/18/01	6	3.65	64,600	160
20B	9/18/01	18	3.72	34,300	100
Average			3.68		

TABLE 2 – LIME RATE APPLICATION SIMILARITY

Swale Section from Location 1A to Location 8

Sample No.	Sample Depth (inches)	Acidity, Total (as $CaCO_3$) (MG/KG)	Locations Compared	AVERAGE OF TOTAL ACIDITY	20% OF AVERAGE	High Value (Average plus 20% of Average)	Low Value (Average minus 20% of Average)	Similar? (YES/NO)
1A-A	6	400						
1A-B	18	360						
21A	6	300	1A -A; 21A	350	70	420	280	YES
21B	18	820						
1A	6	340	21A; 1A	320	64	384	256	YES
1B	18	200						
22A	6	660	1A; 22A	500	100	600	400	NO
22B	18	800						
23A	6	80	22A; 23A	370	74	444	296	NO
23B	18	120						
8A	6	700	23A; 8A	390	78	468	312	NO
8B	18	150						

TABLE 2 – LIME RATE APPLICATION SIMILARITY (continued)

North Railroad Ditch from Location 2 to Location 19

Sample No.	Sample Depth (inches)	Acidity, Total (as $CaCO_3$) (MG/KG)	Locations Compared	AVERAGE OF TOTAL ACIDITY	20% OF AVERAGE	High Value (Average plus 20% of Average)	Low Value (Average minus 20% of Average)	Similar? (YES/NO)
2A	6	180						
2B	18	160						
4A	6	100	2A; 4A	140	28	168	112	NO
4B	18	200						
6A	6	500	4A; 6A	300	60	360	240	NO
6B	18	520						
9A	6	800	6A; 9A	650	130	780	520	NO
9B	18	400						
11A	6	140	9A; 11A	470	94	564	376	NO
11B	18	140						
13A	6	300	11A; 13A	220	44	264	176	NO
13B	18	280						
15A	6	500	13A; 15A	400	80	480	320	NO
15B	18	700						
17A	6	340	15A; 17A	420	84	504	336	YES
17B	18	340						
19A	6	400	17A; 19A	370	74	444	296	YES
19B	18	360						

TABLE 2 – LIME RATE APPLICATION SIMILARITY (continued)

South Railroad Ditch from Location 3 to Location 20

Sample No.	Sample Depth (inches)	Acidity, Total (as $CaCO_3$) (MG/KG)	Locations Compared	AVERAGE OF TOTAL ACIDITY	20% OF AVERAGE	High Value (Average plus 20% of Average)	Low Value (Average minus 20% of Average)	Similar? (YES/NO)
3A	6	180						
3B	18	80						
5A	6	160	3A; 5A	170	34	204	136	YES
5B	18	200						
7A	6	700	5A; 7A	430	86	516	344	NO
7B	18	300						
10A	6	640	7A; 10A	670	134	804	536	YES
10B	18	800						
12A	6	640	10A; 12A	640	128	768	512	YES
12B	18	440						
14A	6	460	12A; 14A	550	110	660	440	YES
14B	18	120						
16A	6	680	14A; 16A	570	114	684	456	YES
16B	18	800						
18A	6	160	16A; 18A	420	84	504	336	NO
18B	18	100						
20A	6	160	18A; 20A	160	32	192	128	YES
20B	18	100						

TABLE 3 - PROPOSED SAMPLING LOCATIONS FOR DITCH SECTIONS

Swale Section from Location 1A to Location 8

Sample Location	Total Acidity Similarity	Sample from Midpoint between	Sample to Midpoint Between
1A - 1	Yes	100' upstrm 1A	1 – 22
1 – 22	No	21 – 1	22 - 23
22 – 23	No	1 – 22	23 – 8
23 – 8	No	22 – 23	8

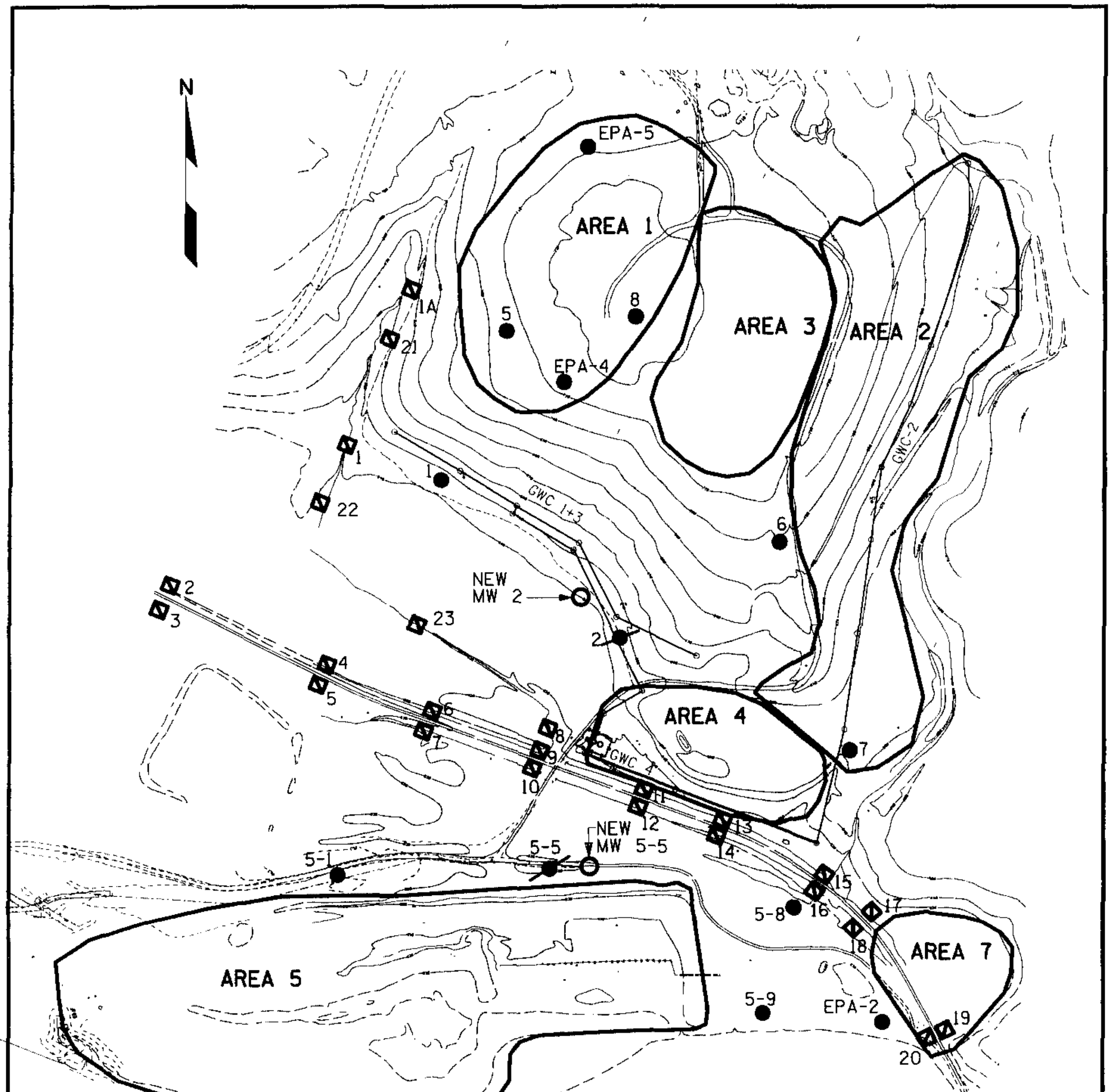
North Railroad Ditch from Location 2 to Location 19

Sample Location	Total Acidity Similarity	Sample from Midpoint between	Sample to Midpoint Between
2 – 4	No	100' upstrm 2	4 – 6
4 – 6	No	2 – 4	6 – 9
6 – 9	No	4 – 6	9 – 11
9 – 11	No	6 – 9	11 – 13
11 –13	No	9 – 11	13 –15
13 –15	No	11 – 13	15 – 17
15 – 19	Yes	13 – 15	19

South Railroad Ditch from Location 3 to Location 20

Sample Location	Total Acidity Similarity	Sample from Midpoint between	Sample to Midpoint Between
3 – 5	Yes	100' upstrm 3	5 – 7
5 – 7	No	3 – 5	7 – 10
7 – 16	Yes	5 – 7	16 – 18
16 – 18	No	14 – 16	18 – 20
18 – 20	Yes	16 – 18	20

AR303204



SAMPLE LOCATIONS FOR pH , TOTAL IRON
20

LEGEND

OLD MONITOR WELL LOCATION

EXISTING MONITOR WELL LOCATION

PROPOSED MONITOR WELL LOCATION

RD/RA AREAS

REV. 9/18/01

EXHIBIT I

MONITORING WELLS
US TITANIUM SUPERFUND SITE
PINEY RIVER , VIRGINIA

Wiley & Wilson
ARCHITECTS ENGINEERS PLANNERS
LYNCHBURG, VIRGINIA

300' 0 300'

FILE NAME: I:\7031\AMCYWELL

BY FTA APPROVED SWL

AR303205

CYTEC RESPONSES TO USEPA COMMENTS (DATED JANUARY 22, 2002) ON THE DECEMBER 5, 2001 REPORT ON RAILROAD RIGHT-OF-WAY EVALUATION FOR THE U.S. TITANIUM SUPERFUND SITE

COMMENT 1:

It is recommended that a Work Plan and project schedule be prepared which specifically addresses the proposed remediation of acidic soil in the railroad right-of-way drainage ditches and the ditch to the southwest of Area 1 which flows through the wetlands.

RESPONSE 1:

Cytec will prepare a Work Plan, including a project schedule for USEPA and VDEQ approval once the Report on the Railroad Right-of-Way Evaluation and responses to comments on the report are accepted.

COMMENT 2:

The extent and volume of acidic soil requiring remediation should be determined and presented following additional sampling to determine appropriate lime application rate.

RESPONSE 2:

As part of the remediation work, additional sampling will be conducted to determine the volume of acidic soil to be treated. As a preliminary estimate, the following is presented: The length of the ditches requiring lime addition (swale, north railroad and south railroad) is approximately 5, 300 feet. The average width (for estimating purposes) is assumed at 36 inches, although some sections will require less than 36-inch width of treatment due to ditch geometry (narrow bottom with steep vegetated sides). The calculated volume of soil requiring lime addition is 589 cubic yards. If a rate of 6 tons per acre were required, the equivalent lime per cubic yard is about 7 ½ pounds, or approximately 4,400 pounds for the length of ditch anticipated.

COMMENT 3:

The suggestion that the contamination is residual in nature based upon the interpretation of results from one sample location (No. 21) is unclear. It this location considered representative of soil conditions throughout the investigation area?

RESPONSE 3:

No, sample location 21 is not considered representative of soil conditions throughout the investigation area. Reference to location 21 was made as an example of an area that has continued to be flushed by groundwater. The interpretation of data leading to the conclusion that the acidity and total iron observed in sections of the swale and railroad ditches is based on the assessment of several samples locations including locations 21, 2, *3 & 8. The section of the report supporting this conclusion has been expanded and is presented below:*

> *"These data for Location 21 seem to indicate that the continued groundwater flow has been providing some flushing of residual iron and acidity at this location. The reason for this conclusion is that all sample points in this swale, including Location 21, are located within drainage paths where, historically (before the Remedial Action removed the source of acidity) low pH surface water and/or ground water was the means of transporting iron and acidity to the swale area. With the exception of this one location (#21) where sufficient groundwater flow continues to seep from the ground, and flush the soil, the other sample locations in this swale exhibit a lower pH and a higher Total Iron level. The Total Acidity remains within the range of the other locations.*
>
> *A similar observation is noted at other locations along the rail road ditches where some flushing continues to occur. At Location 2, surface water from offsite areas provides flushing of the north railroad ditch. At Location 3, a small drainage area from offsite provides flushing action. At Location 8, nearly all surface water runoff from the top of Area 1 to the north, from the Area 3 treated soil mound, and through the wetlands immediately north/northwest of Location 8 drains through the ditch at Location 8, thereby providing significant flushing with fresh water for that single location. Comparing the condition of groundwater flow at Location 21 with the results of flushing conditions at Locations 2, 3, and 8, the similar test results at each location indicate both areas are flushed, albeit from differing water sources and with differing volumes of water.*
>
> *These readings also lend credence to the idea that the iron and acidity in the drainage paths, including the ditches along the old railroad bed, is residual rather than a result of current groundwater discharge to the drainage paths. There are no known remaining source areas to provide continuing high iron and acidity to supply the sampled locations. Observing conditions at the four locations that apparently are flushed with flows of fresh water as compared to other sampled locations and the known most recent history of the site leads to the statement that the high iron and acidity is residual."*

COMMENT 4:

The statement on page 8, first paragraph, that" readings seem to indicate the groundwater has been providing some flushing of residual iron and acidity from the location sampled" is unclear and requires further explanation. Is this suggested solely because total iron and acidity reading are higher in the deeper sample (21B) as compared to the shallower sample (21A)?

RESPONSE 4:

See response to Comment 3.

COMMENT 5:

The discussion on page 8, second paragraph, regarding the determination of final lime application rates is somewhat confusing. The example is given of locations 3 & 5 where total acidity readings are similar and therefore, samples will be collected at 50 foot intervals and composited to determine the final rate. If results aren't similar does the sampling methodology change? In other words, does the sampling interval change and are discrete as opposed to composite samples collected?

RESPONSE 5:

No, if results aren't similar, the sampling methodology of collecting a sample every 50 feet for compositing will not change; however, the length of the sampling segment will change. This section of the report has been expanded to include more examples. In addition, a Table 3 has been added to show the proposed sampling locations for the various ditch sections. Please see Section 4 – FUTURE ACTIONS, Method to Determine Lime Application Rate and Table 3 in the revised report.

COMMENT 6:

The approach for determining the final lime application rate in the drainage ditch located southwest of Area 1 which flows through the wetlands north of the railroad right-of-way should be presented.

RESPONSE 6:

The approach for determining the final lime application rate in the drainage ditch located southwest of Area 1 is the same as for the ditches along the railroad right-of-way. Please see Section 4 – FUTURE ACTIONS, Method to Determine Lime Application Rate and Table 3 in the revised report.

COMMENT 7:

It is indicated that the final rate will be the average of the predetermined rates for the discrete sections tested. Will the predetermined rates be estimated on the basis of mixing results for each individual location? This matter requires further clarification.

RESPONSE 7:

The final rate of lime application will be the average of the predetermined rates for the discrete sections tested that were successful in raising the soil pH of the composited samples to pH 6 and less than section pH 9 after 48 hours. The average will be used to allow for variability of soil acidity over the length of the ditch section. The length of the "discrete" sections will be determined based on the comparison of total acidity between adjacent locations. See Section 4.3 of report.

COMMENT 8:

At each location, samples were collected at depths of 6 and 18 inches, yet lime will be mixed into the soil to a proposed depth of only 12 inches. The basis for this selection of the 12-inch and not the 18-inch depth should be explained.

RESPONSE 8:

The selection of the 12 inch depth for treatment is consistent with the approach approved by USEPA and VDEQ for the treatment of acidic "hot spots" in Areas 2 & 7. The intent of this remediation is to protect site workers and the public using the hiking trail from contact with low pH soils and pounded water at the site. Treatment of the top 12 inches of impacted soils to a pH between 6 and 9 will provide the required level of protection.

COMMENT 9:

It is not clear whether the lime will be applied to the soil manually or using automated equipment such as a rototiller. Please explain.

RESPONSE 9:

The text in the revised report has been expanded to address the method of lime application and is as follows: "The application of lime will be done by one of three methods, hand, small garden rotary tiller, or small backhoe. Where possible, the small, tracked backhoe will dig 12 inches (depth) of soil in the drainage path and incorporate the designated weight of lime (in terms of pounds of lime per cubic foot of soil), then replace the mixture. This activity will occur over short lengths of ditch, beginning on the upstream end of each section. If a tracked backhoe cannot access a length of ditch without damaging the wetlands vegetation or vegetation that is to remain in place, either a small garden tiller and hand work will be used to remove the soil, mix the lime, and replace the mixture. If a tiller cannot access the location, only hand methods will be used. All lengths of the drainage ditches will be limed using one of the three methods."